REMARKS

This is a full and timely response to the Office Action mailed December 10, 2008, submitted concurrently with a one month extension of time to extend the due date for response to April 10, 2009.

By this Amendment, claims 10 and 14 have been amended to address the rejection under 35 U.S.C. §112, second paragraph. Thus, claims 1-16 are currently pending in this application. Support for the claim amendments can be readily found variously throughout the specification and the original claims.

In view of these amendments, Applicant believes that all pending claims are in condition for allowance. Reexamination and reconsideration in light of the above amendments and the following remarks is respectfully requested.

Rejection under 35 U.S.C. §112

Claims 10-16 are rejected under 35 U.S.C. §112, second paragraph, for allegedly being indefinite. Applicant believes that the amendments to claims 10 and 14 overcome this rejection by clarifying that the first drain structure is disposed adjacent to (1) a storage unit adjacent to the readout unit or (2) the readout unit, and that it is the first drain structure which discharges the excess part of the electric signals read by said readout unit. Thus, in view of the amendments to claims 10 and 14, withdrawal of this rejection is respectfully requested.

Rejection under 35 U.S.C. §102

Claims 1-16 are rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Mutoh et al. (U.S. Patent Application Publication No. 2003/0089908). Applicant respectfully traverses this rejection.

To constitute anticipation of the claimed invention under U.S. practice, the prior art reference must literally or inherently teach each and every limitation of the claims. Here, in this case, the cited reference, Mutoh et al., fails to teach or suggest all the claim limitations with particular emphasis on the limitations "*a potential gradient is provided in which potentials about the electric signals gradually change from the light receiver toward said readout unit*", "*said potential*

gradient is provided by gradually enlarging a width of impurities forming said light receiver, from the light receiver to said readout unit", "*said potential gradient is provided by gradually increasing density of impurities forming said light receiver, from the light receiver to said readout unit*", "*a first drain structure is disposed adjacent to (1) a storage unit adjacent to the readout unit or (2) the readout unit, said first drain structure for discharging excess part of the electric signals read by said readout unit*", and "*a second drain structure disposed adjacent the light receiver for discharging excess part of said electric signals in said light receiver*".

The present invention is directed to an image sensor comprising a light receiver, a readout unit, and a first drain structure. The first drain structure is adjacent to a storage unit that is adjacent to a readout unit, or the first drain structure is adjacent to the readout unit itself. A second drain structure may also be included, which is adjacent to the light receiver. The image sensor embodies a potential gradient where potentials about the electric signals gradually change from the light receiver to the readout unit. This design allows for electric signals from the light receiver to be transferred at higher speeds, making the design suitable for high speed photography. This potential gradient is enabled by the particular configuration of impurities that form the light receiver. In one embodiment, the width of such impurities is gradually enlarged from the light receiver to the readout unit. Alternatively, the density of such impurities is gradually increased from the light receiver to the readout unit. Combinations of such impurity configurations may also be constructed.

The Examiner believes that the portions of Mutoh et al. having low levels of impurities and high levels of impurities being arranged in an alternating sequence across the surface of the charge transfer path of a CCD (see paragraph [0012] of Mutoh et al.) read on the claimed feature of gradually increasing the density of impurities for a light receiver of the present invention (see the middle of page 3 of the Office Action). However, based on Applicant's review of Mutoh et al., Applicant strongly disagrees with the Examiner's conclusion in this regard.

Although a potential gradient is produced in Mutoh et al., it is not the same as that recited in the present claims. The present claims require that the potentials about the electric signals gradually change from the light receiver toward a readout unit. In contrast, the arrangement of impurities in Mutoh et al. creates a potential profile arranged in a step configuration (see paragraph [0012] of Mutoh et al.). In other words, as shown in Figures 17 and 18 of Mutoh et al., Mutoh et al.

disclose a potential gradient with low levels of impurities and high levels of impurities being arranged in an alternating sequence. Hence, the potential gradient of Mutoh et al. has a potential profile in a step (unevenness) configuration, which differs from the gradual changes required in claim 1 of the present application. Furthermore, Mutoh et al. takes a CCD charge transfer path 10 as one example, and in order to realize a multiple phase drive (e.g. a two-phase or three-phase drive), applies the same voltage as a multiple phase drive. Thus, for the purpose of the potential gradient in Figures 17 and 18 of Mutoh et al., low levels and high levels of impurities are alternately dispersed and each voltage is controlled. Such teachings in Mutoh et al. are clearly distinct from the gradual change required by the present claims.

Thus, Applicant believes that an alternation of densities taught in Mutoh et al. cannot be interpreted to be equivalent to the gradual increase of densities required by present claims. The gradual change in potential of the present invention allows for the smooth transference of electric signals without stagnation between the light receiver and the readout unit, resulting in the transference of electric signals taking place at high speeds.

It should be noted that, in the present application, the potential gradient gradually changes with the voltage not being applied up to the readout unit in the light receiver. Consequently, the width of impurities will be gradually increased from the light receiver to the readout unit as in claim 2, or the density of impurities will be gradually increased from the light receiver to the readout unit as in claim 3.

The Examiner alleges that Mutoh et al. teaches a potential gradient by gradually enlarging a width of impurities forming a light receiver, where the width of the impurities increases from the light receiver to the readout unit (see the paragraph bridging pages 3 and 4 of the Office Action). However, from Applicant's review, Applicant believes that Mutoh et al. merely disclose that the amount of transferred electric signal charges can be increased by increasing the width of the light receiver (see paragraph [0013] of Mutoh et al.). In other words, Mutoh et al. discloses widening the photo-receptive area of an image sensor to provide an increase in the amount of charges transferred. Hence, Applicant believes that Mutoh et al. fails to teach or suggest that the width of impurities can be gradually increased from the light receiver to the readout unit as in claim 2 of the present application.

In contrast to Mutoh et al., the present invention gradually widens the impurities in a light receiver to construct a mechanism by which a potential gradient is obtained. The result of such a construction in the present invention is an increase of the rate at which the charges are transferred. The present invention therefore shows an inventive improvement, where the rate of transference of electric signals is achieved without merely increasing the area of an image sensor, but is instead achieved by a particular configuration of the impurities within the image sensor.

Furthermore, the present specification does not teach widening a photodiode in positive terms, because of a resulting discrepancy in signal quantity that overwhelms the capability of drain structures in adjusting the signal quantity into a form that can be stored (see page 5, lines 1-7,of the present specification). Thus, Mutoh et al.'s disclosure of widening a photo-receptive area of an image sensor (instead of gradually widening the impurities forming a light receiver) teaches away from the presently claimed invention.

Hence, Applicant believes that Mutoh et al.'s failure to teach the gradual increase of the width or density of impurities from the light receiver to the readout unit is an important distinction between the teachings of Mutoh et al. and the present invention.

Also, in support of the rejection of claims 10 and 14, the Examiner argues that Mutoh et al. describes a particular type of CCD as being used for a vertical read-out (see element 37 of Figures 2-4 and paragraphs [0061] to [0064] in Mutoh et al.) which the Examiner believes, reads on the drain structure adjacent to a readout unit or adjacent to a storage unit that is adjacent to the readout unit of the present invention (see last paragraph on page 5 of the Office Action). However, Applicant disagrees with the Examiner's arguments in this regard.

Claims 10 and 14 specifically require that a plurality of storage units store electric signals that have been read by the readout unit. The claims also require that the readout unit itself read light signals acquired from the light receiver. Thus, it should be understood that the readout unit is situated between the light receiver and the plurality of storage units. However, according to the Examiner's analysis of Mutoh et al., the component that the Examiner has determined to be a readout unit is located distal to the photodiode, with the storage units being located proximal to the photodiode (see elements 33, 36 and 37 of Figures 2-4 of Mutoh et al.). Thus, it is clear that the structure of Mutoh et al.'s device is not the same as the structure of the present invention.

By comparing the features in claims 10-16 of the present application with that of Mutoh et al., Applicant believes that the "readout unit" in claims 10 and 14 of the present application corresponds to the "input gate 38" of Mutoh et al. In other words, Applicant believes that the Examiner has misinterpreted the "readout unit" of claims 10 and 14 as corresponding to the CCD for vertical read-out 37, CCD 39 for horizontal, and amplifier 41 of Mutoh et al. Applicant believes that this misinterpretation was the result of the Examiner's analysis that the description of "read-out" of Mutoh et al. corresponds to the "readout unit" in claims 10 and 14 of the present application. In actuality, the CCD for vertical read-out 37, CCD 39 for horizontal, and amplifier 41 of Mutoh et al. are each a typical transfer path, and thus should be interpreted to correspond to the plurality of storage units in claims 10 and 14 of the present application.

Thus, the drain 43 in Mutoh et al. does not have a construction like the first drain structure of the present application (i.e. disposed adjacent to (1) a storage unit adjacent the readout unit or (2) the readout unit). Instead, the drain 43 is disposed at the end of the CCD for vertical read-out 37, which differs from the Examiner's arguments and conclusions in the Office Action. Hence, Applicant believes that there is no disclosure or suggestion in Mutoh et al. that the first drain structure is disposed adjacent to (1) a storage unit adjacent the readout unit, or (2) the readout unit. For this reason, Mutoh et al. fail to disclose or suggest that the first drain structure of the present invention

Further, the Examiner also alleges that Mutoh et al. discloses a second drain structure adjacent to a light receiver (see first completed paragraph on page 6 of the Office Action). However, the Examiner cites the same drain structure used in the rejection of claims 10 and 14, which, for the reasons outlined above, is clearly not adjacent to the photodiodes described in Mutoh et al. (see Figures 2-4 of Mutoh et al.). Therefore, Applicant believes that Mutoh et al. also fails to teach the second drain structure as described in the present claims.

Thus, for these reasons, withdrawal of the rejection is respectfully requested.

CONCLUSION

For the foregoing reasons, all the claims now pending in the present application are believed to be clearly patentable over the outstanding rejections. Accordingly, favorable reconsideration of the claims in light of the above remarks is courteously solicited. If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the below-listed number.

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Respectfully submitted,

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